AFRL-ML-TY-TR-2006-4536



REFRACTOMETRY AND EXTINGUISHMENT/ BURNBACK TESTING OF PACIFIC AIR FORCES AFFF

Jennifer L. Kalberer, Kimberly D. Barrett

Applied Research Associates, Inc. P.O. Box 40128
Tyndall AFB, FL 32403

Interim Report, April 2006

DISTRIBUTION STATEMENT A:

Approved for public release; distribution unlimited.

Air Force Research Laboratory
Materials and Manufacturing Directorate
Airbase Technologies Division
139 Barnes Drive, Suite 2
Tyndall AFB, FL 32403-5323

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

The public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 2202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any

1. REPORT DATE (PO-MK-PYYY) 3.1-04-2006 3.1-04-2006 4. TITLE AND SUBITILE Refractometry and Extinguishment/Burnback Testing of Pacific Air Forces AFFF 6. AUTHORS) Jennifer L. Kalberer, Kimberly D. Barrett 6. PROGRAM ELEMENT NUMBER SYSSUP 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Applied Research Associates, Inc. PO-D Box 40125 Tyndall AFB, FL 32403 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory Materials and Manufacturing Directorate 139 Bames Drive, Suite 2 Tyndall AFB, EL 32403-5223 12. DISTRIBUTION/AVAILABILITY STATEMENT Distribution Statement A: Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES AFRL/MLQ Poble Affairs Case # 06-038. Document contains color images. 14. ABSTRACT At the request of Pacific Air Forces (PACAF), the Air Force Research Laboratory (AFRL) performed refractometry and extringuishment/burnback tests on samples of Ansulite and 3M aqueous film forming foam (AFFF) from an overseas air base. The Fire Chief at the air hase was concerned about the effectiveness of the agent because of refractometry rests conducted on the foam concentrate and foam dilutions. AFRL used an Atago, Palette Series PR-32a Digital Refractometry testing was completed, two agents were chosen to conduct the Miltary Specifications extinguishment and burnback indicating that they maintain their fire fighting effectiveness. 18. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 18. SUBJECT TERMS Closed cell foam, shelters, fire protection, force protection 18. SUBJECT TERMS Closed cell foam, shelters, fire protection, force protection 19. LELEPHONE NUMBER (PESSON) 190. DESCRIPTION NUMBER (PESSON) 190. DESCRIPTION NUMBER (PESSON) 190. TELEPHONE NUMBER (PESSON) 190. DESCRIPTION NUMBER (PESSON) 190				it does not display a currently vale ABOVE ADDRESS.	lid OMB control nur	nber.	ig any other provision of law, no person shall be subject to any		
4. TITLE AND SUBTITLE Refractometry and Extinguishment/Burnback Testing of Pacific Air Forces AFFF 6. AUTHORIS Jennifer L. Kalberer, Kimberly D. Barrett 6. TASK NUMBER 6. AUTHORIS Jennifer L. Kalberer, Kimberly D. Barrett 6. TASK NUMBER 6. AUTHORIS Jennifer L. Kalberer, Kimberly D. Barrett 6. TASK NUMBER 6. TASK							3. DATES COVERED (From - To)		
Refractometry and Extinguishment/Burnback Testing of Pacific Air Forces AFFF AFFF Benalt Refractor (Air Force) 6. AUTHORIS) Jennifer L. Kalberer, Kimberly D. Barrett 6. AUTHORIS 6. PROGRAM ELEMENT NUMBER 600 T. 6. TASK NUMBER 600 T. 6. TASK NUMBER 600 T. 6. WORK UNIT NUMBER 600 T. 6. PERFORMING ORGANIZATION NUMBER 600 T. 6. PERFORMING ORGANIZATION REPORT NUMBER 7. SPONSORIMGNONITOR'S ACRONYMIS) AFRI.MILQD 7. PERFORMING ORGANIZATION NUMBER 7. BEPORT NUMBER 7. SPONSORIMGNONITOR'S ACRONYMIS) AFRI.MILQD 7. PERFORMING ORGANIZATION NUMBER 7. WORK UNIT NUMBER 7. BEPORT NUMBER 7. BEPORT NUMBER 7. BEPORT NUMBER 7. SPONSORIMGNONITOR'S ACRONYMIS) AFRI.MILQD 7. PERFORMING ORGANIZATION REPORT NUMBER 7. BEPORT	31-	-04-2006		Interim Technica	ıl Report	01-08-2005 30-09-2005			
56. GRANT NUMBER 6. AUTHORIS Jennifer L. Kalberer, Kimberly D. Burrett 6. AUTHORIS Jennifer L. Kalberer, Kimberly D. Burrett 6. AUTHORIS Jennifer L. Kalberer, Kimberly D. Burrett 6. GOVT 6. TASK NUMBER 6. OO 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Applied Research Associates, Inc. P.O. Box 40128 Tyndall AFB, FL 32403 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory Materials and Manufacturing Directorate 139 Barnes Drive, Suite 2 17. Tyndall AFB, FL 32403-5323 12. DISTRIBUTION/AVAILABILITY STATEMENT Distribution Statement A: Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES AFRL/MLQ Public Affairs Case # 06-038. Document contains color images. 14. ABSTRACT At the request of Pacific Air Forces (PACAF), the Air Force Research Laboratory (AFRL) performed refractometry and extinguishment/burnback tests on samples of Ansultie and 3M aqueous film forming foam (AFFF) from an overseas air base. The Fire Chief at the air base was concerned about the effectiveness of the agent because of refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agen/twice mass concerned about the effectiveness of the agent because of refractometry testing showed that even high end, calibrated digital refractometers produce varied results. Alter the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and burnback. Results showed that both AFFF samples exceeded MIL-SPEC minimum requirements for extinguishment and burnback indicating that they maintain their fire fighting effectiveness. 16. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 18. SECURITY CLASSIFICATION OF: 18. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 19. SAR	4. TITLE AND	SUBTITLE	•			5a. CONTRACT NUMBER			
6. AUTHORIS Jennifer L. Kalberer, Kimberly D. Barrett 6. PROJECT NUMBER GOVT 6. TASK NUMBER GOVT0007 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Applied Research Associates, Inc. P.O. Box 40128 Tyndall AFB, FL 32403 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory Materials and Manufacturing Directorate 139 Barnes Drive. Suite 2 Tyndall AFB, FL 32403-5323 10. SPONSOR/MONITOR'S REPORT NUMBER(S) AFRL/MLQD 11. SPONSOR/MONITOR'S REPORT NUMBER(S) AFRL/MLQ Dublic Affairs Case # 06-038. Document contains color images. 13. SuppleaderNATAY NOTES AFRL/MLQ Public Affairs Case # 06-038. Document contains color images. 14. ABSTRACT At the request of Pacific Air Forces (PACAF), the Air Force Research Laboratory (AFRL) performed refractometry and extinguishment burmback tests on samples of Ansulite and 3M aqueous film forming foam (AFFF) from an overseas air base. The Fire Chief at the air hase was concerned about the effectiveness of the agent because of refractometry tests conducted on the foam concentrate and foam dilutions. AFRL used an Atago, Palette Series PR-32a Digital Refractometry tests conducted on the foam concentrate and foam dilutions. AFRL used an Atago, Palette Series PR-32a Digital Refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and bumback. Results showed that both AFFF samples exceeded MIL-SPEC minimum requirements for extinguishment and bumback indicating that they maintain their fire fighting effectiveness. 15. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF THIS PAGE SAR OF THIS PAGE	Refractometry and Extinguishment/Burnback Testing of Pacific Air					F08637-03-C-6006			
8. AUTHORIS Jennifer L. Kalberer, Kimberly D. Barrett 6. AUTHORIS Jennifer L. Kalberer, Kimberly D. Barrett 6. TASK NUMBER GOVT 60. TASK NUMBER GO 61. WORK UNIT NUMBER GOVT 70. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Applied Research Associates, Inc. P.O. Box 40128 Tyndall AFB, FL 32403 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory Materials and Manufacturing Directorate 139 Barnes Drive, Suite 2 Tyndall AFB, FL 32403-5323 10. SPONSORING/MONITORI'S REPORT NUMBER 12. DISTRIBUTION/AVAILABILITY STATEMENT Distribution Statement A: Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES AFRL/MLQ Public Affairs Case # 06-038. Document contains cofor images. 14. ABSTRACT 4. the request of Pacific Air Forces (PACAF), the Air Force Research Laboratory (AFRL) performed refractometry and extinguishment/burnback tests on samples of Ansulite and 3M aqueous film forming foam (AFFF) from an overseas air base. The Fire Chief at the air base was concerned about the effectiveness of the agent because of refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agent/water mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and bumback. Results showed that both was applied for extinguishment and bumback indicating that they maintain their fire fighting effectiveness. 15. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF: ABSTRACT 17. LIMITATION OF ABSTRACT 18. NUMBER 19a. NAME OF RESPONSIBLE PERSON OF PAGES 19d LEPHONE NUMBER include area control 19b. TELEPHONE NUMBER include area control	AFFF					5b. GRANT NUMBER			
8. AUTHORIS Jennifer L. Kalberer, Kimberly D. Barrett 6. AUTHORIS Jennifer L. Kalberer, Kimberly D. Barrett 6. TASK NUMBER GOVT 60. TASK NUMBER GO 61. WORK UNIT NUMBER GOVT 70. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Applied Research Associates, Inc. P.O. Box 40128 Tyndall AFB, FL 32403 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory Materials and Manufacturing Directorate 139 Barnes Drive, Suite 2 Tyndall AFB, FL 32403-5323 10. SPONSORING/MONITORI'S REPORT NUMBER 12. DISTRIBUTION/AVAILABILITY STATEMENT Distribution Statement A: Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES AFRL/MLQ Public Affairs Case # 06-038. Document contains cofor images. 14. ABSTRACT 4. the request of Pacific Air Forces (PACAF), the Air Force Research Laboratory (AFRL) performed refractometry and extinguishment/burnback tests on samples of Ansulite and 3M aqueous film forming foam (AFFF) from an overseas air base. The Fire Chief at the air base was concerned about the effectiveness of the agent because of refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agent/water mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and bumback. Results showed that both was applied for extinguishment and bumback indicating that they maintain their fire fighting effectiveness. 15. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF: ABSTRACT 17. LIMITATION OF ABSTRACT 18. NUMBER 19a. NAME OF RESPONSIBLE PERSON OF PAGES 19d LEPHONE NUMBER include area control 19b. TELEPHONE NUMBER include area control									
8. AUTHORIS Jennifer L. Kalberer, Kimberly D. Barrett 6. AUTHORIS Jennifer L. Kalberer, Kimberly D. Barrett 6. TASK NUMBER GOVT 60. TASK NUMBER GO 61. WORK UNIT NUMBER GOVT 70. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Applied Research Associates, Inc. P.O. Box 40128 Tyndall AFB, FL 32403 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory Materials and Manufacturing Directorate 139 Barnes Drive, Suite 2 Tyndall AFB, FL 32403-5323 10. SPONSORING/MONITORI'S REPORT NUMBER 12. DISTRIBUTION/AVAILABILITY STATEMENT Distribution Statement A: Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES AFRL/MLQ Public Affairs Case # 06-038. Document contains cofor images. 14. ABSTRACT 4. the request of Pacific Air Forces (PACAF), the Air Force Research Laboratory (AFRL) performed refractometry and extinguishment/burnback tests on samples of Ansulite and 3M aqueous film forming foam (AFFF) from an overseas air base. The Fire Chief at the air base was concerned about the effectiveness of the agent because of refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agent/water mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and bumback. Results showed that both was applied for extinguishment and bumback indicating that they maintain their fire fighting effectiveness. 15. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF: ABSTRACT 17. LIMITATION OF ABSTRACT 18. NUMBER 19a. NAME OF RESPONSIBLE PERSON OF PAGES 19d LEPHONE NUMBER include area control 19b. TELEPHONE NUMBER include area control						5c PROGRAM ELEMENT NUMBER			
6. AUTHORIS) Jennifer L. Kalberer, Kimberly D. Barrett 60 PROJECT NUMBER GOVT 60 TASK NUMBER 00 61. WORK UNIT NUMBER GOVT0007 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Applied Research Associates, Inc. P.O. Box 40128 Tyndall AFB, FL 32403 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Aff Force Research Laboratory Materials and Manufacturing Directorate 139 Barnes Drive, Suite 2 Tyndall AFB, FL 32403-5523 12. DISTRIBUTION/AVAILABILITY STATEMENT Distribution Statement A: Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES AFRL/MLQ Public Affairs Case # 06-038. Document contains color images. 14. ABSTRACT At the request of Pacific Air Forces (PACAF), the Air Force Research Laboratory (AFRL) performed refractometry and extinguishment/burnback tests on samples of Ansulite and 3M aqueous film forming foam (AFFF) from an overseas air base. The Fire Chief at the air base was concerned about the effectiveness of the agent because of refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agent/ware mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and burnback. Results showed that both AFFF samples exceeded MIL-SPEC minimum requirements for extinguishment and burnback indicating that they maintain their fire fighting effectiveness. 15. SUBJECT TERMS closed for Institution of ABSTRACT 16. SECURITY CLASSIFICATION OF: 16. SECURITY CLASSIFICATION OF: 17. LIMITATION OF PAGES 18. NUMBER 19. NUMB									
Jennifer L. Kalberer, Kimberly D. Barrett GOVT									
5e. TASK NUMBER 00 5f. WORK UNIT NUMBER 00 5f. WORK UNIT NUMBER GOVT0007 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Applied Research Associates, Inc. P.O. Box 40128 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory Materials and Manufacturing Directorate 139 Barnes Drive, Suite 2 Tyndall AFB, FL 32403-5323 12. DISTRIBUTION/AVAILABILITY STATEMENT Distribution Statement A: Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES AFRL/MLQ Public Affairs Case # 06-038. Document contains color images. AFRL/MLQ Public Affairs Case # 06-038. Document contains color images. AFRL/MLQ Public Affairs Case # 06-038. Document contains color images. The Fire Chief at the air base was concerned about the effectiveness of the agent because of refractometry tests conducted on the foam concentrate and foam dilutions. AFRL used an Atago, Palette Series PR-32a Digital Refractometer to perform refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agent/water mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agent/water mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agent/water mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agent/water mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing on fives samples. Each agent was such as a five and three test were conducted with each agent/water mixture. Testing showed that they			de D. Damett			5d. PRC			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Applied Research Associates, Inc. P.O. Box 40128 Tyndall AFB, FL 32403 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory Materials and Manufacturing Directorate 139 Barnes Drive, Suite 2 Tyndall AFB, FL 32403-5323 12. DISTRIBUTION/AVAILABILITY STATEMENT Distribution Statement A: Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES AFRL/MLQ Public Affairs Case # 06-038. Document contains color images. 14. ABSTRACT At the request of Pacific Air Forces (PACAF), the Air Force Research Laboratory (AFRL) performed refractometry and extinguishment/burnback tests on samples of Ansulite and 3M aqueous film forming foam (AFFF) from an overseas air base. The Fire Chief at the air base was concerned about the effectiveness of the agent because of refractometry tests conducted on the foam concentrate and foam dilutions. AFRL used an Atago, Palette Series PR-32a Digital Refractometry tests conducted on the foam concentrate and foam dilutions. AFRL used an Atago, Palette Series PR-32a Digital Refractometry tests on surples showed that even high end, calibrated digital refractometrs produce varied results. After the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and burnback. Results showed that both AFFF samples exceeded MIL-SPEC minimum requirements for extinguishment and burnback indicating that they maintain their fire fighting effectiveness. 15. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF: 17. LIMITATION OF PAGES ABSTRACT 18. NUMBER 19. TELEPHONE NUMBER (Include area code)	Jenniier L. Ka	ilberer, Kimbei	Ty D. Barrett				GOVT		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Applied Research Associates, Inc. P.O. Box 40128 Tyndall AFB, FL 32403 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory Materials and Manufacturing Directorate 139 Barnes Drive, Suite 2 Tyndall AFB, FL 32403-5233 10. SPONSORIMO/MONITORING AGENCY NAME(S) AND ADDRESS(ES) AFRL/MLQD 11. SPONSOR/MONITOR'S ACRONYM(S) AFRL/MLQD 11. SPONSOR/MONITOR'S REPORT NUMBER(S) AFRL/MLQD 12. DISTRIBUTION/AVAILABILITY STATEMENT Distribution Statement A: Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES AFRL/MLQ Public Affairs Case # 06-038. Document contains color images. 14. ABSTRACT At the request of Pacific Air Forces (PACAF), the Air Force Research Laboratory (AFRL) performed refractometry and extinguishment burnback tests on samples of Ansulite and 3M aqueous film forming foam (AFFF) from an overseas air base. The Fire Chief at the air base was concerned about the effectiveness of the agent because of refractometry tests conducted on the foam concentrate and foam dilutions. AFRL used an Atago, Palette Series PR-32a Digital Refractometre to perform refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agent/water mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and burnback. Results showed that both AFFF samples exceeded MIL-SPEC minimum requirements for extinguishment and burnback indicating that they maintain their fire fighting effectiveness. 15. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF: 17. LIMITATION OF PAGES SAR 18. NUMBER 19. B. NUMBER 19. B. NAME OF RESPONSIBLE PERSON Virgil Carr 19. B. TELEPHONE NUMBER (include area code)						5e. TASK NUMBER			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Applied Research Associates, Inc. P.O. Box 40128 Tyndall AFB, FL 32403 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory Materials and Manufacturing Directorate 139 Barnes Drive, Suite 2 Tyndall AFB, FL 32403-5323 12. DISTRIBUTION/AVAILABILITY STATEMENT Distribution Statement A: Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES AFRL/MLQ Public Affairs Case # 06-038. Document contains color images. 14. ABSTRACT At the request of Pacific Air Forces (PACAF), the Air Force Research Laboratory (AFRL) performed refractometry and extinguishment/burnback tests on samples of Ansulite and 3M aqueous film forming foam (AFFF) from an overseas air base. The Fire Chief at the air base was concerned about the effectiveness of the agent because of refractometry tests conducted on the foam concentrate and foam dilutions. AFRL used an Atago, Palette Series PR-32a Digital Refractometre to perform refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agent/water mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and burnback. Results showed that both AFFF samples exceeded MIL-SPEC minimum requirements for extinguishment and burnback indicating that they maintain their fire fighting effectiveness. 16. SECURITY CLASSIFICATION OF: 17. LIMITATION OF PAGES 18. NUMBER 19a. NAME OF RESPONSIBLE PERSON Virgil Carr 19b. TELEPHONE NUMBER (Include area code)							00		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Applied Research Associates, Inc. P.O. Box 40128 Tyndall AFB, FL 32403 3. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory Materials and Manufacturing Directorate 139 Barnes Drive, Suite 2 Tyndall AFB, FL 32403-5523 12. DISTRIBUTION/AVAILABILITY STATEMENT Distribution Statement A: Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES AFRL/MLQ Public Affairs Case # 06-038. Document contains color images. 14. ABSTRACT At the request of Pacific Air Forces (PACAF), the Air Force Research Laboratory (AFRL) performed refractometry and extinguishment/burnback tests on samples of Ansulite and 3M aqueous film forming foam (AFFF) from an overseas air base. The Fire Chief at the air base was concerned about the effectiveness of the agent because of refractometry tests conducted on the foam concentrate and foam dilutions. AFRL used an Atago, Palette Series PR-32a Digital Refractometer to perform refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agent/water mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and burnback. Results showed that both AFFF samples exceeded MIL-SPEC minimum requirements for extinguishment and burnback indicating that they maintain their fire fighting effectiveness. 15. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT 18. NUMBER PAGES 19a. NAME OF RESPONSIBLE PERSON Virgil Carr 19b. TELEPHONE NUMBER (Include area code)						5f. WORK UNIT NUMBER			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Applied Research Associates, Inc. P.O. Box 40128 Tyndall AFB, FL 32403 3. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory Materials and Manufacturing Directorate 139 Barnes Drive, Suite 2 Tyndall AFB, FL 32403-5523 12. DISTRIBUTION/AVAILABILITY STATEMENT Distribution Statement A: Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES AFRL/MLQ Public Affairs Case # 06-038. Document contains color images. 14. ABSTRACT At the request of Pacific Air Forces (PACAF), the Air Force Research Laboratory (AFRL) performed refractometry and extinguishment/burnback tests on samples of Ansulite and 3M aqueous film forming foam (AFFF) from an overseas air base. The Fire Chief at the air base was concerned about the effectiveness of the agent because of refractometry tests conducted on the foam concentrate and foam dilutions. AFRL used an Atago, Palette Series PR-32a Digital Refractometer to perform refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agent/water mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and burnback. Results showed that both AFFF samples exceeded MIL-SPEC minimum requirements for extinguishment and burnback indicating that they maintain their fire fighting effectiveness. 15. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT 18. NUMBER PAGES 19a. NAME OF RESPONSIBLE PERSON Virgil Carr 19b. TELEPHONE NUMBER (Include area code)						GOVT0007			
Applied Research Associates, Inc. P.O. Box 40128 Tyndall AFB, FL 32403 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory Materials and Manufacturing Directorate 139 Barnes Drive, Suite 2 Tyndall AFB, FL 32403-5323 11. SPONSOR/MONITOR'S ACRONYM(S) AFRL/MLQD Tyndall AFB, FL 32403-5323 12. DISTRIBUTION/AVAILABILITY STATEMENT Distribution Statement A: Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES AFRL/MLQ Public Affairs Case # 06-038. Document contains color images. 14. ABSTRACT At the request of Pacific Air Forces (PACAF), the Air Force Research Laboratory (AFRL) performed refractometry and extinguishment/burnback tests on samples of Ansulite and 3M aqueous film forming foam (AFFF) from an overseas air base. The Fire Chief at the air base was concerned about the effectiveness of the agent because of refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agent/water mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and burnback. Results showed that both AFFF samples exceeded MIL-SPEC minimum requirements for extinguishment and burnback indicating that they maintain their fire fighting effectiveness. 15. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT OF PAGES 11. SAR 19a. NAME OF RESPONSIBLE PERSON Virgil Carr 19b. TELEPHONE NUMBER (Include area code)	7 DEDECIDADA	IC ODCANIZATI	ON NAME(S) A	ID ADDRESS(ES)					
P.Ö. BOX 40128 Tyndall AFB, FL 32403 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory Materials and Manufacturing Directorate 139 Barnes Drive, Suite 2 Tyndall AFB, FL 32403-5323 12. DISTRIBUTION/AVAILABILITY STATEMENT Distribution Statement A: Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES AFRL/ML/Q Public Affairs Case # 06-038. Document contains color images. 14. ABSTRACT At the request of Pacific Air Forces (PACAF), the Air Force Research Laboratory (AFRL) performed refractometry and extinguishment/burnback tests on samples of Ansulite and 3M aqueous film forming foam (AFFF) from an overseas air base. The Fire Chief at the air base was concerned about the effectiveness of the agent because of refractometry tests conducted on the foam concentrate and foam dilutions. AFRL used an Atago, Palette Series PR-32a Digital Refractometer to perform refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agent/water mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and burnback. Results showed that both AFFF samples exceeded MIL-SPEC minimum requirements for extinguishment and burnback indicating that they maintain their fire fighting effectiveness. 15. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT SAR 18. NUMBER 19a. NAME OF RESPONSIBLE PERSON Virgil Carr PAGES OF PAGES OF THE PROVEN NUMBER (Include area code)									
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory Materials and Manufacturing Directorate 139 Barnes Drive, Suite 2 Tyndall AFB, FL 32403-5323 12. DISTRIBUTION/AVAILABILITY STATEMENT Distribution Statement A: Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES AFRL/MLQ Public Affairs Case # 06-038. Document contains color images. 14. ABSTRACT At the request of Pacific Air Forces (PACAF), the Air Force Research Laboratory (AFRL) performed refractometry and extinguishment/burnback tests on samples of Ansulite and 3M aqueous film forming foam (AFFF) from an overseas air base. The Fire Chief at the air base was concerned about the effectiveness of the agent because of refractometry tests conducted on the foam concentrate and foam dilutions. AFRL used an Atago, Palette Series PR-32a Digital Refractometre to perform refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agent/water mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and burnback. Results showed that both AFFF samples exceeded MIL-SPEC minimum requirements for extinguishment and burnback indicating that they maintain their fire fighting effectiveness. 15. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT SAR 18. NUMBER 19a. NAME OF RESPONSIBLE PERSON Virgil Carr 19b. TELEPHONE NUMBER (Include area code)			s, IIIC.						
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Research Laboratory Materials and Manufacturing Directorate 139 Barnes Drive, Suite 2 Tyndall AFB, FL 32403-5323 Tyndall AFB, FL 32403-5323 T2. DISTRIBUTION/AVAILABILITY STATEMENT Distribution Statement A: Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES AFRL/MLQ Public Affairs Case # 06-038. Document contains color images. 14. ABSTRACT At the request of Pacific Air Forces (PACAF), the Air Force Research Laboratory (AFRL) performed refractometry and extinguishment/burnback tests on samples of Ansulite and 3M aqueous film forming foam (AFFF) from an overseas air base. The Fire Chief at the air base was concerned about the effectiveness of the agent because of refractometry tests conducted on the foam concentrate and foam dilutions. AFRL used an Atago, Palette Series PR-32a Digital Refractometer to perform refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agent/water mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and burnback. Results showed that both AFFF samples exceeded MIL-SPEC minimum requirements for extinguishment and burnback indicating that they maintain their fire fighting effectiveness. 15. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF: 17. LIMITATION OF PAGES SAR 18. NUMBER 19a. NAME OF RESPONSIBLE PERSON Virgil Carr 19b. TELEPHONE NUMBER (include area code)		-							
Air Force Research Laboratory Materials and Manufacturing Directorate 139 Barnes Drive, Suite 2 Tyndall AFB, FL 32403-5323 12. DISTRIBUTION/AVAILABILITY STATEMENT Distribution Statement A: Approved for public release; distribution unlimited. 13. SUPPLEMENTARY MOTES AFRL/MLQ Public Affairs Case # 06-038. Document contains color images. 14. ABSTRACT At the request of Pacific Air Forces (PACAF), the Air Force Research Laboratory (AFRL) performed refractometry and extinguishment/burnback tests on samples of Ansulite and 3M aqueous film forming foam (AFFF) from an overseas air base. The Fire Chief at the air base was concerned about the effectiveness of the agent because of refractometry tests conducted on the foam concentrate and foam dilutions. AFRL used an Atago, Palette Series PR-32a Digital Refractometre to perform refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agent/water mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and burnback. Results showed that both AFFF samples exceeded MIL-SPEC minimum requirements for extinguishment and burnback indicating that they maintain their fire fighting effectiveness. 15. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT OF THE PAGES OF THE									
Materials and Manufacturing Directorate 139 Barnes Drive, Suite 2 Tyndall AFB, FL 32403-5233 12. DISTRIBUTION/AVAILABILITY STATEMENT Distribution Statement A: Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES AFRL/MLQ Public Affairs Case # 06-038. Document contains color images. 14. ABSTRACT At the request of Pacific Air Forces (PACAF), the Air Force Research Laboratory (AFRL) performed refractometry and extinguishment/burnback tests on samples of Ansulite and 3M aqueous film forming foam (AFFF) from an overseas air base. The Fire Chief at the air base was concerned about the effectiveness of the agent because of refractometry tests conducted on the foam concentrate and foam dilutions. AFRL used an Atago, Palette Series PR-32a Digital Refractometer to perform refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agent/water mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and burnback. Results showed that both AFFF samples exceeded MIL-SPEC minimum requirements for extinguishment and burnback indicating that they maintain their fire fighting effectiveness. 16. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT 18. NUMBER OF PAGES OF PAGES OF PAGES OF PAGES OF TELEPHONE NUMBER (Include area code)	9. SPONSORIN	IG/MONITORING	AGENCY NAM	E(S) AND ADDRESS(ES)			10. SPONSOR/MONITOR'S ACRONYM(S)		
11. SPONSOR/MONITOR'S REPORT NUMBER(S) AFRL-ML-TY-TR-2006-4536 12. DISTRIBUTION/AVAILABILITY STATEMENT Distribution Statement A: Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES AFRL/MLQ Public Affairs Case # 06-038. Document contains color images. 14. ABSTRACT At the request of Pacific Air Forces (PACAF), the Air Force Research Laboratory (AFRL) performed refractometry and extinguishment/burnback tests on samples of Ansulite and 3M aqueous film forming foam (AFFF) from an overseas air base. The Fire Chief at the air base was concerned about the effectiveness of the agent because of refractometry tests conducted on the foam concentrate and foam dilutions. AFRL used an Atago, Palette Series PR-32a Digital Refractometre to perform refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agent/water mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and burnback. Results showed that both AFFF samples exceeded MIL-SPEC minimum requirements for extinguishment and burnback indicating that they maintain their fire fighting effectiveness. 16. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT OF PAGES SAR 19a. NAME OF RESPONSIBLE PERSON Virgil Carr 19b. TELEPHONE NUMBER (Include area code)							AFRL/MLQD		
Tyndall AFB, FL 32403-5323 NUMBER(S) AFRL-ML-TY-TR-2006-4536 12. DISTRIBUTION/AVAILABILITY STATEMENT Distribution Statement A: Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES AFRL/MLQ Public Affairs Case # 06-038. Document contains color images. 14. ABSTRACT At the request of Pacific Air Forces (PACAF), the Air Force Research Laboratory (AFRL) performed refractometry and extinguishment/burnback tests on samples of Ansulite and 3M aqueous film forming foam (AFFF) from an overseas air base. The Fire Chief at the air base was concerned about the effectiveness of the agent because of refractometry tests conducted on the foam concentrate and foam dilutions. AFRL used an Atago, Palette Series PR-32a Digital Refractometer to perform refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agent/water mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and burnback. Results showed that both AFFF samples exceeded MIL-SPEC minimum requirements for extinguishment and burnback indicating that they maintain their fire fighting effectiveness. 16. SECURITY CLASSIFICATION OF: 17. LIMITATION OF ABSTRACT OF PAGES SAR 19a. NAME OF RESPONSIBLE PERSON Virgil Carr 19b. TELEPHONE NUMBER (Include area code)						11 CRONCOR/MONITOR'S DEPORT			
Distribution Statement A: Approved for public release; distribution unlimited. 13. SUPPLEMENTARY NOTES AFRL/MLQ Public Affairs Case # 06-038. Document contains color images. 14. ABSTRACT At the request of Pacific Air Forces (PACAF), the Air Force Research Laboratory (AFRL) performed refractometry and extinguishment/burnback tests on samples of Ansulite and 3M aqueous film forming foam (AFFF) from an overseas air base. The Fire Chief at the air base was concerned about the effectiveness of the agent because of refractometry tests conducted on the foam concentrate and foam dilutions. AFRL used an Atago, Palette Series PR-32a Digital Refractometer to perform refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agent/water mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and burnback. Results showed that both AFFF samples exceeded MIL-SPEC minimum requirements for extinguishment and burnback indicating that they maintain their fire fighting effectiveness. 15. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF: a. REPORT b. ABSTRACT c. THIS PAGE SAR 17. LIMITATION OF ABSTRACT OF PAGES									
13. SUPPLEMENTARY NOTES AFRL/MLQ Public Affairs Case # 06-038. Document contains color images. 14. ABSTRACT At the request of Pacific Air Forces (PACAF), the Air Force Research Laboratory (AFRL) performed refractometry and extinguishment/burnback tests on samples of Ansulite and 3M aqueous film forming foam (AFFF) from an overseas air base. The Fire Chief at the air base was concerned about the effectiveness of the agent because of refractometry tests conducted on the foam concentrate and foam dilutions. AFRL used an Atago, Palette Series PR-32a Digital Refractometer to perform refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agent/water mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and burnback. Results showed that both AFFF samples exceeded MIL-SPEC minimum requirements for extinguishment and burnback indicating that they maintain their fire fighting effectiveness. 15. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF: a. REPORT b. ABSTRACT c. THIS PAGE SAR 17. LIMITATION OF ABSTRACT OF PAGES OF PAGE	Tylldall AFB,	FL 32403-332	3			AFRL-ML-TY-TR-2006-4536			
13. SUPPLEMENTARY NOTES AFRL/MLQ Public Affairs Case # 06-038. Document contains color images. 14. ABSTRACT At the request of Pacific Air Forces (PACAF), the Air Force Research Laboratory (AFRL) performed refractometry and extinguishment/burnback tests on samples of Ansulite and 3M aqueous film forming foam (AFFF) from an overseas air base. The Fire Chief at the air base was concerned about the effectiveness of the agent because of refractometry tests conducted on the foam concentrate and foam dilutions. AFRL used an Atago, Palette Series PR-32a Digital Refractometer to perform refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agent/water mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and burnback. Results showed that both AFFF samples exceeded MIL-SPEC minimum requirements for extinguishment and burnback indicating that they maintain their fire fighting effectiveness. 15. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF: a. REPORT b. ABSTRACT c. THIS PAGE SAR SAR OF PAGES OF PA	12. DISTRIBUT	ION/AVAILABIL	TY STATEMEN	Г					
13. SUPPLEMENTARY NOTES AFRL/MLQ Public Affairs Case # 06-038. Document contains color images. 14. ABSTRACT At the request of Pacific Air Forces (PACAF), the Air Force Research Laboratory (AFRL) performed refractometry and extinguishment/burnback tests on samples of Ansulite and 3M aqueous film forming foam (AFFF) from an overseas air base. The Fire Chief at the air base was concerned about the effectiveness of the agent because of refractometry tests conducted on the foam concentrate and foam dilutions. AFRL used an Atago, Palette Series PR-32a Digital Refractometer to perform refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agent/water mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and burnback. Results showed that both AFFF samples exceeded MIL-SPEC minimum requirements for extinguishment and burnback indicating that they maintain their fire fighting effectiveness. 15. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF: a. REPORT b. ABSTRACT c. THIS PAGE SAR SAR OF PAGES OF PA	Distribution S	tatement A: A	pproved for pu	blic release; distribution	on unlimited.				
Document contains color images. 14. ABSTRACT At the request of Pacific Air Forces (PACAF), the Air Force Research Laboratory (AFRL) performed refractometry and extinguishment/burnback tests on samples of Ansulite and 3M aqueous film forming foam (AFFF) from an overseas air base. The Fire Chief at the air base was concerned about the effectiveness of the agent because of refractometry tests conducted on the foam concentrate and foam dilutions. AFRL used an Atago, Palette Series PR-32a Digital Refractometer to perform refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agent/water mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and burnback. Results showed that both AFFF samples exceeded MIL-SPEC minimum requirements for extinguishment and burnback indicating that they maintain their fire fighting effectiveness. 15. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF: a. REPORT b. ABSTRACT c. THIS PAGE SAR 18. NUMBER OF RESPONSIBLE PERSON Virgil Carr 19b. TELEPHONE NUMBER (Include area code)									
14. ABSTRACT At the request of Pacific Air Forces (PACAF), the Air Force Research Laboratory (AFRL) performed refractometry and extinguishment/burnback tests on samples of Ansulite and 3M aqueous film forming foam (AFFF) from an overseas air base. The Fire Chief at the air base was concerned about the effectiveness of the agent because of refractometry tests conducted on the foam concentrate and foam dilutions. AFRL used an Atago, Palette Series PR-32a Digital Refractometer to perform refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agent/water mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and burnback. Results showed that both AFFF samples exceeded MIL-SPEC minimum requirements for extinguishment and burnback indicating that they maintain their fire fighting effectiveness. 15. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF: a. REPORT b. ABSTRACT c. THIS PAGE SAR NUMBER 19a. NAME OF RESPONSIBLE PERSON Virgil Carr 19b. TELEPHONE NUMBER (Include area code)									
At the request of Pacific Air Forces (PACAF), the Air Force Research Laboratory (AFRL) performed refractometry and extinguishment/burnback tests on samples of Ansulite and 3M aqueous film forming foam (AFFF) from an overseas air base. The Fire Chief at the air base was concerned about the effectiveness of the agent because of refractometry tests conducted on the foam concentrate and foam dilutions. AFRL used an Atago, Palette Series PR-32a Digital Refractometer to perform refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agent/water mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and burnback. Results showed that both AFFF samples exceeded MIL-SPEC minimum requirements for extinguishment and burnback indicating that they maintain their fire fighting effectiveness. 15. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF: a. REPORT D. ABSTRACT C. THIS PAGE T. LIMITATION OF ABSTRACT SAR T. LIMITATION OF PAGES T. LIMITATION OF ABSTRACT T. LIMITAT	Document con	ntains color im	ages.						
extinguishment/burnback tests on samples of Ansulite and 3M aqueous film forming foam (AFFF) from an overseas air base. The Fire Chief at the air base was concerned about the effectiveness of the agent because of refractometry tests conducted on the foam concentrate and foam dilutions. AFRL used an Atago, Palette Series PR-32a Digital Refractometer to perform refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agent/water mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and burnback. Results showed that both AFFF samples exceeded MIL-SPEC minimum requirements for extinguishment and burnback indicating that they maintain their fire fighting effectiveness. 15. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF: a. REPORT b. ABSTRACT c. THIS PAGE T. LIMITATION OF ABSTRACT SAR T. LIMITATION OF PAGES T. LIMITATIO			Formas (DACA	E) the Air Force Page	orah I aharat	om: (AED	I) norformed refrectements and		
Fire Chief at the air base was concerned about the effectiveness of the agent because of refractometry tests conducted on the foam concentrate and foam dilutions. AFRL used an Atago, Palette Series PR-32a Digital Refractometer to perform refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agent/water mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and burnback. Results showed that both AFFF samples exceeded MIL-SPEC minimum requirements for extinguishment and burnback indicating that they maintain their fire fighting effectiveness. 15. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF: a. REPORT b. ABSTRACT c. THIS PAGE B. ABSTRACT C. THIS PAGE SAR 18. NUMBER OF RESPONSIBLE PERSON Virgil Carr 19b. TELEPHONE NUMBER (Include area code)	-		*	* *		• .	, <u>*</u>		
concentrate and foam dilutions. AFRL used an Atago, Palette Series PR-32a Digital Refractometer to perform refractometry testing on fives samples. Each agent was mixed twice and three test were conducted with each agent/water mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and burnback. Results showed that both AFFF samples exceeded MIL-SPEC minimum requirements for extinguishment and burnback indicating that they maintain their fire fighting effectiveness. 15. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF: a. REPORT b. ABSTRACT C. THIS PAGE SAR 18. NUMBER OF PAGES Virgil Carr 19b. TELEPHONE NUMBER (Include area code)	_		-	-		•			
on fives samples. Each agent was mixed twice and three test were conducted with each agent/water mixture. Testing showed that even high end, calibrated digital refractometers produce varied results. After the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and burnback. Results showed that both AFFF samples exceeded MIL-SPEC minimum requirements for extinguishment and burnback indicating that they maintain their fire fighting effectiveness. 15. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF: a. REPORT b. ABSTRACT c. THIS PAGE SAR 17. LIMITATION OF ABSTRACT OF PAGES OF PAGES SAR 18. NUMBER OF RESPONSIBLE PERSON Virgil Carr 19b. TELEPHONE NUMBER (Include area code)					_				
even high end, calibrated digital refractometers produce varied results. After the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and burnback. Results showed that both AFFF samples exceeded MIL-SPEC minimum requirements for extinguishment and burnback indicating that they maintain their fire fighting effectiveness. 15. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF: a. REPORT b. ABSTRACT c. THIS PAGE SAR SAR 19a. NAME OF RESPONSIBLE PERSON Virgil Carr PAGES 19b. TELEPHONE NUMBER (Include area code)				-		-			
were chosen to conduct the Military Specification extinguishment and burnback. Results showed that both AFFF samples exceeded MIL-SPEC minimum requirements for extinguishment and burnback indicating that they maintain their fire fighting effectiveness. 15. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF: a. REPORT b. ABSTRACT c. THIS PAGE SAR	_	_							
MIL-SPEC minimum requirements for extinguishment and burnback indicating that they maintain their fire fighting effectiveness. 15. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF: a. REPORT b. ABSTRACT c. THIS PAGE ABSTRACT SAR									
15. SUBJECT TERMS closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF: a. REPORT b. ABSTRACT c. THIS PAGE ABSTRACT SAR 18. NUMBER OF PAGES O									
closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF: a. REPORT b. ABSTRACT c. THIS PAGE SAR 17. LIMITATION OF ABSTRACT OF PAGES OF PAGE	bi Le minimum requirements for examguishment and outhoack indicating that they maintain their fire fighting effectiveness.								
closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF: a. REPORT b. ABSTRACT c. THIS PAGE SAR 17. LIMITATION OF ABSTRACT OF PAGES OF PAGE									
closed cell foam, shelters, fire protection, force protection 16. SECURITY CLASSIFICATION OF: a. REPORT b. ABSTRACT c. THIS PAGE SAR 17. LIMITATION OF ABSTRACT OF PAGES OF PAGE									
16. SECURITY CLASSIFICATION OF: a. REPORT b. ABSTRACT c. THIS PAGE SAR 17. LIMITATION OF ABSTRACT OF PAGES OF PAGE			: 6	:					
a. REPORT b. ABSTRACT c. THIS PAGE SAR OF PAGES OF Virgil Carr 19b. TELEPHONE NUMBER (Include area code)	closed cell for	am, shelters, fir	e protection, fo	orce protection					
a. REPORT b. ABSTRACT c. THIS PAGE SAR OF PAGES OF Virgil Carr 19b. TELEPHONE NUMBER (Include area code)	16. SECURITY	CLASSIFICATIO	N OF:		18. NUMBER	19a. NAI	ME OF RESPONSIBLE PERSON		
II II SAR 9 19b. TELEPHONE NUMBER (Include area code)				ABSTRACT	OF				
	U	U	U	SAR		19b. TEL			

NOTICES

USING GOVERNMENT DRAWINGS, SPECIFICATIONS, OR OTHER DATA INCLUDED IN THIS DOCUMENT FOR ANY PURPOSE OTHER THAN GOVERNMENT PROCUREMENT DOES NOT IN ANY WAY OBLIGATE THE US GOVERNMENT. THE FACT THAT THE GOVERNMENT FORMULATED OR SUPPLIED THE DRAWINGS, SPECIFICATIONS, OR OTHER DATA DOES NOT LICENSE THE HOLDER OR ANY OTHER PERSON OR CORPORATION; OR CONVEY ANY RIGHTS OR PERMISSION TO MANUFACTURE, USE, OR SELL ANY PATENTED INVENTION THAT MAY RELATE TO THEM.

THIS REPORT IS RELEASABLE TO THE NATIONAL TECHNICAL INFORMATION SERVICE

5285 PORT ROYAL RD.

SPRINGFIELD VA 22161

TELEPHONE 703-487-4650; 703-487-4639 (TDD for the hearing-impaired)

E-MAIL

orders@ntis.fedworld.gov

www

http://www.ntis.gov/index.html

AT NTIS, IT WILL BE AVAILABLE TO THE GENERAL PUBLIC, INCLUDING FOREIGN NATIONS.

THIS TECHNICAL REPORT HAS BEEN REVIEWED AND IS APPROVED FOR PUBLICATION.

VIRGA). CARR

Leader, Fire Research Group

RICHARD N/VICKERS

MICHAEL R. UPDIKE, Lt Col, USAF

Chief, Deployed Base Systems Branch Chief, Airbase Technologies Division

Do not return copies of this report unless contractual obligations or notice on a specific document requires its return.

Table of Contents

INTRODUCTION	1
METHODS AND RESULTS	1
CONCLUSIONS	
RECOMMENDATIONS	4

INTRODUCTION

At the request of Pacific Air Forces (PACAF), the Air Force Research Laboratory (AFRL) performed refractometry and extinguishment/burnback tests on samples of Ansulite and 3M aqueous film forming foam (AFFF) from an overseas air base. The Fire Chief at the air base was concerned about the effectiveness of the agent because of refractometry tests conducted on the foam concentrate and foam dilutions. During July and August, 2005 AFRL performed refractometry testing on fives samples and extinguishment/burnback tests on two samples.

METHODS AND RESULTS

Refractometer

AFRL used an Atago, Palette Series PR-32a Digital Refractometer (Figure 1) to conduct testing. AFRL switched to this model last year when problems were experienced with the optical style refractometer (Figure 2). Testing was accomplished by mixing 30 ml of agent with 970 ml of water. Each agent was mixed twice and three tests were conducted with each agent/water mixture. Table 1 shows data from measuring refractometry at a carefully measured 3% concentration. Testing showed that even high end, calibrated digital refractometers produce varied results. The Ansulite sample read as low as 2.3%, while the 3M 560 and 131 read as high as 3.7%. Most measurements were $3\% \pm 0.3\%$.



Figure 1. Atago Digital Refractometer with Digital Readout.



Figure 2. Typical Optical Refractometer with Analog Readout.

		Manf.	Refractometer Test Results		
Manufacturer	Batch Number	Date	#1	#2	#3
Ansulite	X27062	Dec-87	2.7%	2.7%	2.7%
			2.3%	2.3%	2.3%
3M	560	Sep-89	3.7%	3.7%	3.7%
			3.3%	3.3%	3.0%
3M	131	Dec-90	3.3%	3.3%	3.3%
			3.3%	3.3%	3.7%
3M	141	Mar-91	3.3%	3.0%	3.0%
			3.3%	3.3%	3.3%
3M	30042	Dec-98	2.3%	2.3%	2.3%
			2.3%	2.3%	2.3%

The second set of refractometer tests was accomplished by mixing dilutions of agent with water. The agents were baselined against Ansulite AFFF purchased by AFRL within the past six months. Table 2 showed variation across a range of concentrations, indicating that using a refractometer only provided an estimate of the actual foam concentration and that several samples should be evaluated to determine concentration.

Refractometer test results						
Manufacturer	Foam Concentration	100%	50%	6%	3%	
AFRL Ansulite Baseline						
w/calibration constant		97.85	53.74	5.80	2.44	
Ansulite						
w/calibration constant		102.64	53.74	6.28	2.92	
3M						
w/calibration constant		133.33	75.31	8.19	4.36	
3M						
w/calibration constant		139.08	72.44	7.71	3.88	
3M						
w/calibration constant		132.85	60.93	5.32	3.88	
3M						
w/calibration constant		103.12	51.82	5.80	2.92	

MIL-SPEC Extinguishment And Burnback

After the refractometry testing was completed, two agents were chosen to conduct the Military Specification extinguishment and burnback. Procedures from MIL-F-24385F Fire Extinguishing Agent, Aqueous Film Forming Foam (AFFF) Liquid Concentrate, For Fresh and Sea Water, Section 4.7.13 for the 28 ft² fire test were followed.

Extinguishment Procedures

The fire tests were conducted in level, circular pans that were six foot in diameter, fabricated from $\frac{1}{4}$ inch thick steel with a four inch high side. A shallow water layer less than one inch in depth was used to protect the bottom of the pan and ensure complete coverage of the area with fuel. The nozzle used for foam application delivered 2 gal/min at 100 psi. Foam was generated at 23 °C \pm 5.0 °C from agent solutions made with fresh water. The fuel used for testing was 10 gallons of unleaded gasoline (~0.6 inch fuel depth). All agent solutions were thoroughly mixed prior to testing.

The fuel was added then ignited within a 30 second period and allowed to burn freely for 10 seconds. After the preburn period, the burning fuel was extinguished as expeditiously as possible and the fire extinguishment time was recorded at the cessation of all flame and the foam application continued for a total of 90 seconds.

Burnback Procedure

Within 60 seconds of the completion of foam application, a burning pan (1 foot in diameter with 2 inch side) containing 1 gallon of unleaded gasoline was placed in the center of the 28 ft² pan and a timer started. When the fire had spread outside the pan so that burning continued, the pan was removed. The burnback time was that time at which 7 ft² (25 percent) of the total area was in flames. Intermittent flashovers were not considered part of the burnback area unless sustained burning occurred. All isolated, sustained burning areas were included in arriving at the seven ft² (or 25%) total area. Table 3 shows that both foams passed MIL-SPEC extinguishment and burnback.

Results showed that both the Ansulite and 3M PACAF AFFF samples exceeded MIL-SPEC minimum requirements for extinguishment and burnback, indicating that they should maintain their fire fighting effectiveness.

Table 3. MIL-SPEC Extinguishment and Burnback Testing.

Experiment Number	Agent	Pre-Burn Time (s)	Extinguishment Time (s)	25% Burnback Time (s)
NFPA Min Req't	3% Freshwater	10	30	360
1	Ansulite (# 1)	12	28	402
2	Ansulite (# 1)	10	32	347
3	3M (# 2)	10	25	397

CONCLUSIONS

Refractometry testing only provides a gross approximation of foam percentage. Switching from an optical to digital refractometer will improve results but variation may still exist. Confirmation of the foams in an actual fire scenario (extinguishment/burnback) confirmed that the foams are still effective and can be used for their intended purpose.

RECOMMENDATIONS

AFRL recommends replacing optical refractometers with digital refractometers. Digital refractometers are easy to read and give an exact number versus an analog scale, which can be difficult to interpret and can vary from person to person (Figures 1 and 2). At least three samples should be evaluated and compared to a baseline using foam and water from the site. If the results are not within \pm 0.5%, recalibrate the instrument and rerun new samples. If results are still out of range, send a sample to AFRL for analysis. AFRL can also provide information on selecting a digital refractometer and help establish procedures for conducting foam concentration measurements.